(19)日本国特許庁（ＪＰ）　(12) **公開特許公報(A)**　(11)特許出願公開番号

特開平6－76202

(43)公開日　平成6年(1994)3月18日

(51)Int.Cl.[5]		識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｇ１１Ｂ	5/02	Ｂ	7426－5Ｄ		
	5/127	Ｂ	7303－5Ｄ		

審査請求　未請求　請求項の数5(全 6 頁)

(21)出願番号　特願平4－226582

(22)出願日　平成4年(1992)8月26日

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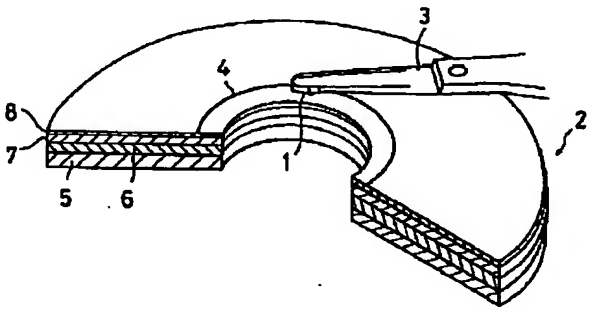
(54)【発明の名称】　磁気記録再生装置

(57)【要約】

【目的】本発明は、例えばハードディスク装置等の磁気記録再生装置に係わり、特にノイズを小さくして高密度記録に適した信頼性の高い磁気記録再生装置を提供することを目的とする。

【構成】本発明の磁気記録再生装置は、軟磁性裏打ち層とその上に形成した垂直磁気異方性記録層とからなる垂直記録媒体を用い、媒体からの信号を再生する際に磁界を発生する素子を有する再生ヘッドから構成される。



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【特許請求の範囲】

【請求項1】　基板上に軟磁性裏打ち層及び垂直磁気異方性を有する磁化記録層が積層された垂直磁気記録媒体と、この垂直磁気記録媒体に対して信号磁化を記録再生する磁気ヘッドとからなる磁気記録再生装置において、前記磁気ヘッドは、信号再生時に前記軟磁性裏打ち層の所定領域に対して磁界を印加可能な磁界発生素子を具備したことを特徴とする磁気記録再生装置。

【請求項2】　前記磁気ヘッドの信号再生時における軟磁性裏打ち層内の磁界強度は軟磁性裏打ち層の有する保磁力より大きく、かつ、磁化記録層内の磁界強度は磁化記録層の垂直方向の保磁力より小さいことを特徴とする請求項1記載の磁気記録再生装置。

【請求項3】　前記磁界発生素子は断面積Sの導体であって、前記磁界発生素子を流れる電流密度Jの電流中心から前記軟磁性裏打ち層までの距離d、前記軟磁性裏打ち層は保磁力Hc の場合に、

$J > 2\pi dHc / S$

を満足することを特徴とする請求項1記載の磁気記録再生装置。

【請求項4】　前記磁界発生素子は、磁気的に硬質な磁性膜からなることを特徴とする請求項1記載の磁気記録再生装置。

【請求項5】　前記磁界発生素子に流れる電流は交流電流であることを特徴とする請求項3記載の磁気記録再生装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、例えばハードディスク装置等の磁気記録再生装置に関するものであり、特に垂直磁気異方性層に軟磁性層が裏打ちされた2層構造の垂直磁気記録媒体及びこの垂直磁気記録媒体に記録された信号磁化を再生する磁気ヘッドにより構成された磁気記録再生装置に関するものである。

【0002】

【従来の技術】近年、ハードディスク装置等の磁気記録装置は、コンピュータ分野においてランダムアクセス可能な大容量の外部記憶装置として利用が盛んである。そして、利用の拡大に伴い、記憶容量の大容量化および高記録密度化に対する要求がますます高まっている。そこで、そのような要求に応えるべく多方面から研究開発がなされている。

【0003】一般に、ハードディスク装置としては、円板状の非磁性基板上に磁性層を設けてなる複数のディスクがシリンダ状に積み重ねて設けられ、この各ディスク面にアームを介して配置された記録再生用のヘッドは、アクチュエータにより動かされて位置決めを行なうようにした構造のものが知られている。このような構造のハードディスク装置によって情報の記録再生を行なう際に、ヘッドは、高速で回転するディスク面に直接接触せず、わずかに浮上した状態でディスク面の所望の位置にアクセスするように配置されており、ディスク面に形成された同心円状のトラックに対して、信号を記録し、或いは再生を行う。

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【0004】上記のハードディスク装置において、記憶容量の大容量化の要求に応えるためには、例えば、ディスクの線記録密度、すなわちトラック方向の密度を高めることにより記録密度を向上させたり、或いはトラック密度を高めることにより記録密度を向上させようとする試み等が、これまでにもなされている。近年、さらに記録密度を高めるため、ヘッドを記録媒体にほぼ接触させて信号を記録再生する接触記録の研究開発も精力的に行なわれている。

【0005】線記録密度を高める方法の1つとして、垂直磁気記録方式が知られている。この垂直磁気記録方式は、従来の面内方向に異方性を有する面内磁気記録方式に比べ、磁化転移部分での減磁界が原理上非常に小さくなり、磁化転移幅が狭く高密度に記録することが可能となった。また、短冊状の軟磁性薄膜を用いた垂直磁気ヘッドによって、より垂直な方向の記録磁界が得られ、高密度化に有効であることが確認されている。さらに、記録及び再生効率を上げ、より急峻な磁化転移を形成するために、垂直異方性層の下に軟磁性裏打ち層を設けた垂直2層構造磁気記録媒体も提案され、開発が進められている。この垂直2層構造磁気記録媒体は、ヘッドと軟磁性裏打ち層との磁気的な相互作用により、ヘッド先端の減磁界を減らし、より大きな発生磁界を得ることができる。また、再生時においては、ヘッド先端での減磁界が小さいために、実効透磁率が大きくなり、媒体からの磁束が効率よくヘッドに集束され、大きな信号を得ることができる。

【0006】しかしながら、上記従来の垂直2層構造磁気記録媒体においては、軟磁性裏打ち層を用いた場合に、信号再生時にヘッドの接触による圧力や、再生磁束で磁化されたヘッドからの微弱な磁界等によって軟磁性層の磁壁が不連続に移動し、パルス状のノイズが発生して、信号品質を著しく低下させてしまうという問題があった。また、軟磁性裏打ち層の保磁力が小さい（透磁率が大きい）ほどヘッドと軟磁性裏打ち層との磁気的な相互作用により記録再生効率を上げることができる反面、裏打ち層の軟磁気特性がよくなると、逆に磁壁が移動しやすくなり、信号再生中に磁壁移動によるパルス状ノイズが発生し、これにより信号品質が低下し、信号再生のエラー率が上昇し、信頼性を損ねてしまうという問題があった。

【0007】

【発明が解決しようとする課題】上述したように、軟磁性裏打ち層を用いた場合においては、信号再生時にヘッドの接触による圧力や、再生磁束で磁化されたヘッドからの微弱な磁界等によって軟磁性層の磁壁が不連続に移

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動することにより、パルス状のノイズが発生し、信号品質を著しく低下させてしまうという問題があった。また、軟磁性裏打ち層の保磁力が小さい（透磁率が大きい）ほどヘッドと軟磁性裏打ち層との磁気的な相互作用により記録再生効率を上げることができる反面、軟磁性裏打ち層の軟磁気特性がよくなると、逆に磁壁が移動しやすくなり、信号再生中に磁壁移動によるパルス状ノイズが発生し、これにより信号品質が低下し、信号再生のエラー率が上昇し、信頼性を損ねてしまうという問題があった。

【０００８】そこで、本発明は、信号再生時における軟磁性裏打ち層の磁壁移動を抑制し、パルス状ノイズの発生を効果的に抑制することにより、高密度記録に適した磁気記録媒体を提供することを目的とする。

【０００９】

【課題を解決するための手段】本発明の磁気記録再生装置は、基板上に軟磁性裏打ち層及び垂直磁気異方性を有する磁化記録層とが積層された垂直磁気記録媒体と、この垂直磁気記録媒体に対して信号磁化を記録再生する磁気ヘッドとからなる磁気記録再生装置において、前記磁気ヘッドは、信号再生時に前記軟磁性裏打ち層の所定領域に対して磁界を印加可能な磁界発生素子を具備する。

【００１０】そして、前記磁気ヘッドの信号再生時における軟磁性裏打ち層内の磁界強度は軟磁性裏打ち層の有する保磁力より大きく、かつ、磁化記録層内の磁界強度は磁化記録層の垂直方向の保磁力より小さくなるようにする。

【００１１】また、前記磁界発生素子は断面積Ｓの導体であって、前記磁界発生素子を流れる電流密度Ｊの電流中心から前記軟磁性裏打ち層までの距離ｄ、前記軟磁性裏打ち層は保磁力Hc の場合に、

$$J > 2\pi d Hc / S$$

を満足するようにする。

【００１２】

【作用】本発明によれば、信号再生時に磁気ヘッドを流れるセンス電流は、磁気ヘッド直下の軟磁性裏打ち層の内部に面内方向の磁界を発生させ、その磁界により軟磁性層の磁壁を固着し、或いは、一方向に磁化させることによって磁壁を消滅させる。従って、垂直磁気異方性層の記録磁化に影響を与えることなく軟磁性裏打ち層の磁壁移動は抑制され、急激な磁壁移動によるパルス状ノイズの発生を抑制することができるようになる。

【００１３】また、軟磁性裏打ち層の保持力Hc よりも大きな印加磁界を軟磁性裏打ち層に印加すると、ヘッド再生素子周囲に位置する軟磁性裏打ち層内の磁壁は固着され、ヘッド再生素子の再生感度が最も高いヘッド直下においては急激な磁壁移動は起こらない。ここで、印加磁界は、直流電流や硬質磁性膜による直流磁界、或いは交流電流による交流磁界である。また、交流磁界、特に高周波磁界を印加した場合には、本来、磁壁移動型である軟磁性裏打ち層が磁化回転型の磁化反転を繰り返し、磁壁移動が起きにくくなる。さらに、垂直異方性を有する磁化記録層内における印加磁界の磁界強度を磁化記録層の保磁力よりも小さくすることによって、この印加磁界は記録信号を担う磁化記録層の磁化に何ら影響を及ぼさない。

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【００１４】従って、本発明によれば、信号再生時における軟磁性裏打ち層の磁壁移動を抑制し、パルス状ノイズの発生を効果的に抑制することができると共に、磁化記録層の磁化は印加磁界に何ら影響を受けないので、信号品質の劣化を防ぐことができる。

【００１５】

【実施例】以下、図面を参照し、本発明の実施例について説明する。

（実施例１）

【００１６】図１は、本発明の一実施例に係る磁気記録再生装置の構成を示す部分断面斜視図である。本実施例の磁気記録再生装置は、磁気ヘッド１及び垂直磁気記録媒体２からなっている。

【００１７】磁気ヘッド１は、垂直磁気記録媒体に記録された磁化信号を再生するための厚さ０．０２［μm］、高さ３［μm］のパーマロイ薄膜等からなる磁気抵抗効果素子（ＭＲ素子）であり、アーム３を介して垂直磁気記録媒体２に非接触で対設されている。また、この磁気ヘッド１は、垂直磁気記録媒体２に同心円状に複数形成された所望のトラック４にアクチュエータ（図示せず）によって位置決めされる。

【００１８】垂直磁気記録媒体２は、非磁性の円板状の基板５上に軟磁性裏打ち層６、垂直磁気異方性を有する磁化記録層７が順次積層され、さらにその上に保護層８が形成されている。具体的には、１．８インチ径の厚さ０．４［mm］のガラス製の基板５の上に、アルゴンガス雰囲気中で高周波スパッタ法によりＣｏＺｒＮｂ微結晶からなる軟磁性裏打ち層２を厚さ０．１［μm］形成した。軟磁性裏打ち層６の面内方向保磁力Hcsは１０［Ｏｅ］であった。さらにその上に、アルゴンガス雰囲気中でＤＣマグネトロンスパッタ法により、厚さ０．０７［μm］のＣｏＰｔからなる垂直磁気異方性を有する磁化記録層７を形成した。磁化記録層７の垂直方向保磁力Hchは、２０００［Ｏｅ］であった。磁化記録層７の上には、ヘッドの接触に対する耐久性を確保するため硬質カーボンからなる保護層８をマイクロ波励振ＥＣＲスパッタ法により厚さ０．０１［μm］形成した。

【００１９】図２は、ヘッド・媒体相対移動方向の縦断面を示す模式図である。垂直磁気記録媒体２は、図中矢印Ａの方向に回転移動する。磁気ヘッド１の断面積Ｓは6×10^{-14} m² であり、磁気ヘッド１と垂直磁気記録媒体表面の潤滑保護膜８との間隔は、０．０１［μm］であった。磁気ヘッド１には、信号再生時にトラックの幅方向（紙面に垂直な方向）に電流密度Ｊのセンス電流

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Ｉを流した。なお、電流密度Ｊと断面積Ｓ及びセンス電流Ｉは、Ｊ＝Ｉ／Ｓの関係となっている。また、このセンス電流Ｉは、ＭＲ素子の抵抗変化を電圧変化に変換するための電流であると共に、軟磁性裏打ち層６に磁界Ｈを印加するための電流であり、これにより磁界発生素子としての機能を持つ。磁気ヘッド１を流れるセンス電流Ｉの中心から軟磁性裏打ち層２の表面までの距離ｄは、１．５９［μｍ］であった。そして、磁気ヘッド１を流れる電流の電流密度Ｊは、

【００２０】

【数１】Ｊ＞２πｄＨｃｓ／Ｓ

を満足するようするため、すなわち、１．３３×10^{11}Ａ／m^2 以上になるように２×10^{11}Ａ／m^2 に設定した。

【００２１】以上のように構成された磁気記録再生装置の磁気ヘッド１を流れるセンス電流Ｉは、磁気ヘッド１直下の軟磁性裏打ち層６の内部に面内方向の磁界Ｈを発生させ、その磁界により軟磁性層の磁壁を固着し、或いは、一方向に磁化させることによって磁壁を消滅させる。従って、垂直磁気異方性層７の記録磁化に影響を与＊

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＊えることなく軟磁性裏打ち層６の磁壁移動は抑制され、急激な磁壁移動によるパルス状ノイズの発生を抑制することができ、信号品質を高めることができた。

【００２２】また、交流電流、すなわち、周波数１［ＭＨｚ］のセンス電流Ｉを磁気ヘッド１に流して高周波磁界を印加した場合には、本来、磁壁移動型である軟磁性裏打ち層６が磁化回転型の磁化反転を繰り返すので磁壁移動が起きにくくなり、パルス状ノイズの発生を抑制することができた。

【００２３】なお、信号再生時の垂直磁気異方性層７内部における磁界強度は最大１６［Ｏｅ］であり、垂直磁気異方性層７の保磁力Ｈｃｈ＝２０００［Ｏｅ］よりはるかに小さいため記録磁化に影響を与えることはない。

【００２４】表１は、磁気ヘッド１に流す電流の電流密度Ｊをパラメータとして、Ｊ／（２πｄＨｃｓ／Ｓ）を種々変化させた場合の再生信号出力と軟磁性裏打ち層６からのパルス状ノイズの振幅比を示したものである。

【００２５】

【表１】

Ｊ／（２πｄＨｃｓ／Ｓ）	パルス状ノイズ振幅 ／ 再生信号出力
３．００	０．０１４
１．５０	０．０２１
１．１０	０．０４５
０．９０	０．１５０
０．５０	０．２４０

【００２６】表１より、磁気ヘッド１に流す電流の電流密度Ｊが増加し、Ｊ／（２πｄＨｃｓ／Ｓ）が増加すると、パルス状ノイズの振幅比が小さくなり、信号品質が向上する。特に、Ｊ／（２πｄＨｃｓ／Ｓ）が１より大きくなり、数式１を満足すると、急激にパルス状ノイズが抑制され、記録装置をエラーなく稼働させる目安である値（０．０５）を下回る。

（実施例２）

【００２７】図３は、本発明の一実施例に係る磁気記録再生装置の構成を示す縦断面図である。垂直磁気記録媒体２に記録された磁化信号を再生するための磁気ヘッド１は誘導型垂直磁気ヘッドであり、具体的には、ベース９の一側面には巻線１０を有する磁極１１が設けられ、これらは絶縁層１２及び保護樹脂１３で封止されている。この磁極１１は、ＦｅＳｉＮ高透磁率膜により形成されている。また、ベース９の底面には、ＣｏＳｍから

なる硬質磁性材１４が磁極１１と接触しないように嵌合されている。この硬質磁性材１４は、垂直磁気記録媒体２の面に対してほぼ平行に磁化Mで磁化されている。

【００２８】一方、垂直磁気記録媒体２は、２．５インチ径の厚さ０．６３５［mm］のガラス製の基板５上に、アルゴンガス雰囲気中でＤＣマグネトロンスパッタ法によりＦｅＳｉからなる軟磁性裏打ち層１５を厚さ０．１２［μm］形成した。この軟磁性裏打ち層１５の面内方向保磁力Hcsは６［Ｏｅ］であった。さらにその上に、厚さ０．０４［μm］のスパッタカーボン中間層１６を介して、厚さ０．１［μm］のＣｏＣｒ合金からなる垂直磁気異方性を有する磁化記録層３３をアルゴンガス雰囲気中でＤＣマグネトロンスパッタ法により形成した。このＣｏＣｒからなる垂直磁気異方性を有する磁気記録層１７の垂直方向の保磁力Hchは、１６００［Ｏｅ］であった。磁化記録層１７上には、ヘッドの接触に対する耐久性を確保するためＳｉＮからなる保護膜１８をＲＦスパッタ法により厚さ０．００５［μm］形成した。

【００２９】以上のような構成により、磁化Mの硬質磁性材１４は、その磁化により軟磁性裏打ち層１５に磁界を印加し、実施例１と同様に磁壁移動は抑制される。従って、軟磁性裏打ち層１５の磁壁移動によるパルス状ノイズを低減し、信号品質を向上させることができる。

【００３０】なお、本実施例のおける軟磁性裏打ち層１５内での印加磁界強度は約３０［Ｏｅ］であり、軟磁性裏打ち層１５の保磁力Hcsを上回っているので、印加磁界が記録信号を担う磁化記録層の磁化に何ら影響を及ぼすことはない。

（実施例３）

【００３１】図４は、本発明の一実施例に係る磁気記録再生装置の構成を示す部分断面斜視図である。磁気ヘッド１は、ＭＲ素子１９の両端に厚さ０．０２［μm］のＣｏＰｔからなる硬質磁性材２０，２０及びＭＲ素子１９にセンス電流Ｉを導入するための導体２１，２１が設けられている。導体２１，２１の導体間距離Ｄは、垂直磁気記録媒体に形成されるトラック幅Tw を規定する。なお、導体２１，２１の導体間距離Ｄとトラック幅Twとの関係はＤ＞Tw が望ましい。

【００３２】垂直磁気記録媒体２は、２．５インチ径の厚さ０．６３５［mm］のアルミ製の基板５上に、ＮｉＦｅからなる軟磁性裏打ち層２２をアルゴンガス雰囲気中でＤＣマグネトロンスパッタ法により厚さ０．２［μm］形成した。軟磁性裏打ち層２２の面内方向保磁力Hcsは１２［Ｏｅ］であった。さらにその上に、ＣｏＣｒＴａからなる垂直磁気異方性を有する磁化記録層２３をアルゴンガス雰囲気中でＤＣマグネトロンスパッタ法により厚さ０．０８［μm］の形成した。この磁化記録層２３の垂直方向保磁力Hchは、１９００［Ｏｅ］であった。磁化記録層２３上には、ヘッドの接触に対する耐久性を確保するため、ＺｒＯからなる絶縁性の保護膜２４をＲＦスパッタ法により厚さ０．００７［μm］形成した。

【００３３】硬質磁性材２０，２０は、トラックの幅方向（基板の半径方向）に磁化Mを有し、その磁化Mにより軟磁性裏打ち層の内部にトラック幅方向の磁界を印加する。硬質磁性材２０，２０によるトラック幅方向の磁界強度は、約２０［Ｏｅ］であり、軟磁性裏打ち層２３の保磁力Hcsを上回る。これにより、前述の実施例と同様に、軟磁性裏打ち層２３の磁壁移動によるパルス状ノイズを低減し、信号品質を向上させることができた。

【００３４】なお、本発明の実施例においては、基板の一方の面にのみ軟磁性裏打ち層及び磁化記録層を積層したが、これにこだわることはなく、基板の他方の面にも積層した両面型の垂直磁気記録媒体であっても構わない。

【００３５】

【発明の効果】本発明によれば、軟磁性裏打ち層を用いた垂直磁気記録媒体であっても、信号再生時における軟磁性裏打ち層の磁壁移動を抑制し、パルス状ノイズの発生を効果的に抑制することができる。また、磁化記録層の磁化は印加磁界に何ら影響を受けないので、信号品質の劣化を防ぐことができる。従って、垂直磁気記録の高密度記録特性を損なうことなく、ＳＮの大きな高品質の再生信号を得ることが可能となる。

【図面の簡単な説明】

【図１】　本発明の一実施例に係る磁気記録再生装置の構成を示す部分断面斜視図。

【図２】　図１におけるヘッド・媒体相対移動方向の縦断面を示す模式図

【図３】　本発明の一実施例に係る磁気記録再生装置の構成を示す縦断面図。

【図４】　本発明の一実施例に係る磁気記録再生装置の構成を示す部分断面斜視図。

【符号の説明】

１　磁気ヘッド
２　垂直磁気記録媒体
３　アーム
４　トラック
５　基板
６，１５，２２　軟磁性裏打ち層
７，１７，２３　垂直磁気異方性層
８，１８，２４　保護膜
９　ベース
１０　巻線
１１　磁極
１２　絶縁層
１３　保護樹脂
１４，２０　硬質磁性材
１６　中間層

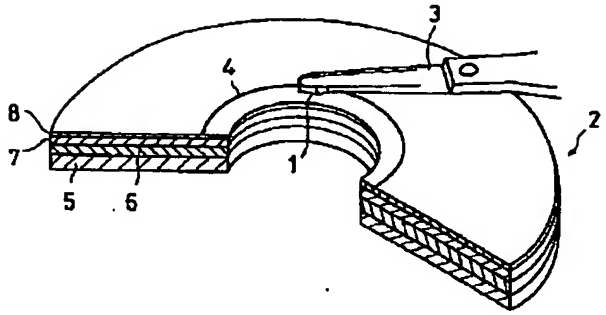
9

1 9　MR素子

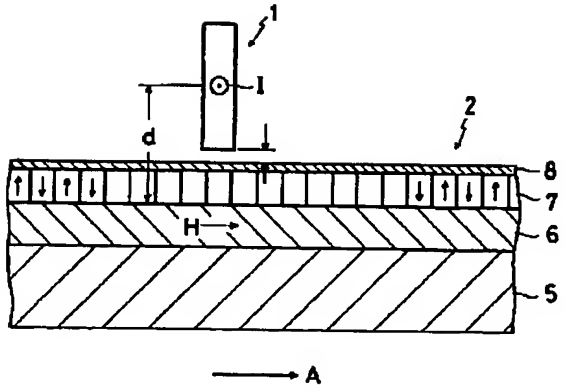
10

2 1　導体

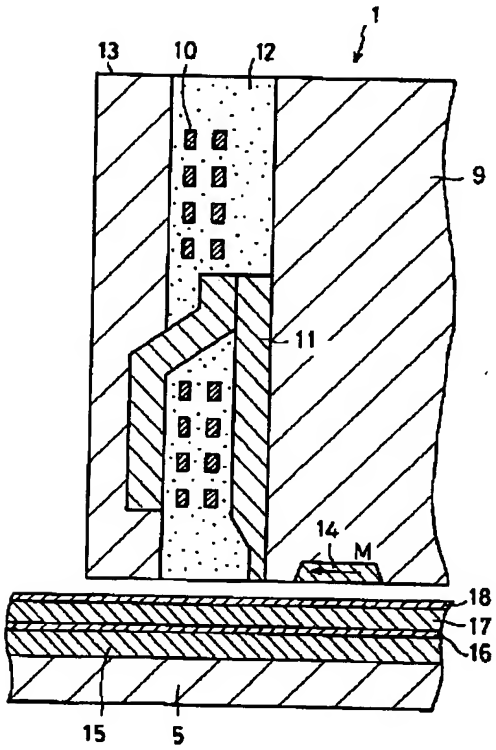
【図1】



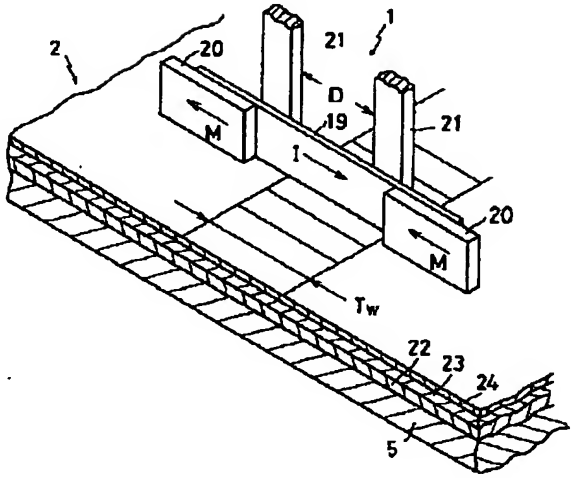
【図2】



【図3】



【図4】



PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-076202

(43)Date of publication of application : 18.03.1994

(51)Int.Cl. G11B 5/02
G11B 5/127

(21)Application number : 04-226582

(22)Date of filing : 26.08.1992

(71)Applicant : TOSHIBA CORP

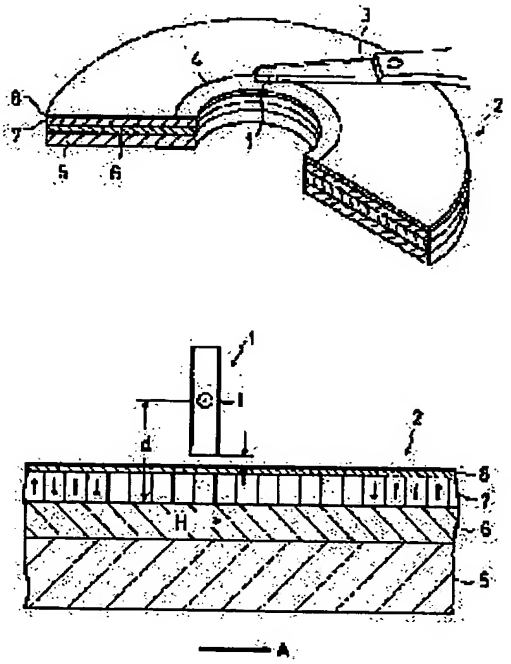
(72)Inventor : TANAKA YOICHIRO

(54) MAGNETIC RECORDING AND REPRODUCING DEVICE

(57)Abstract:

PURPOSE: To suppress the generation of impulsive noises by providing a magnetic field generating element which can impress magnetic fields to the prescribed region of a soft magnetic backing layer at the time of signal reproduction.

CONSTITUTION: This perpendicular magnetic recording medium 2 is constituted by successively laminating the soft magnetic backing layer 6 and a magnetization recording layer 7 having perpendicular magnetic anisotropy on a nonmagnetic disk-shaped substrate 5. Further, a protective layer 8 is formed thereon. Sense current I flowing in the magnetic head 1 of this magnetic recording and reproducing device generates the magnetic field H in an intra-surface direction within the soft magnetic backing layer 6 right under the magnetic head 1 and the magnetic walls of the soft magnetic layer are fixed by this magnetic field or is magnetized in one direction, by which the magnetic walls are dissipated. Then, the magnetic wall transfer of the soft magnetic backing layer 6 is suppressed without affecting the recording magnetization of the perpendicular magnetic anisotropy layer 7. The generation of the impulsive noises by the abrupt magnetic wall transfer is suppressed.



LEGAL STATUS

[Date of request for examination]	30.03.1999
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3126507
[Date of registration]	02.11.2000
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision	

of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] It is the magnetic recorder and reproducing device characterized by for said magnetic head to possess the field generating component which can impress a field to the predetermined field of said soft-magnetism backing layer in the magnetic recorder and reproducing device with which the magnetization record layer which has a soft magnetism backing layer and a perpendicular magnetic anisotropy on a substrate consists of a vertical-magnetic-recording medium by which the laminating was carried out, and the magnetic head which carries out record playback of the signal magnetization to this vertical-magnetic-recording medium at the time of signal regeneration.
[Claim 2] It is the magnetic recorder and reproducing device according to claim 1 characterized by the magnetic field strength in the soft magnetism backing layer at the time of the signal regeneration of said magnetic head being larger than the coercive force which a soft magnetism backing layer has, and the magnetic field strength in a magnetization record layer being smaller than the coercive force of the perpendicular direction of a magnetization record layer.
[Claim 3] The distance d and said soft magnetism backing layer from the current core of current density J of said field generating component being the conductor of the cross section S, and flowing said field generating component to said soft magnetism backing layer are coercive force Hc. To a case, it is J. > Magnetic recorder and reproducing device according to claim 1 characterized by satisfying 2pidHc/S.
[Claim 4] Said field generating component is a magnetic recorder and reproducing device according to claim 1 characterized by consisting of a hard magnetic film magnetically.
[Claim 5] The current which flows for said field generating component is a magnetic recorder and reproducing device according to claim 3 characterized by being alternating current.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the magnetic recorder and reproducing device constituted by the magnetic head which reproduces the signal magnetization recorded on the vertical-magnetic-recording medium and this vertical-magnetic-recording medium of the two-layer structure where the soft magnetism layer was backed by especially the perpendicular magnetic-anisotropy layer about magnetic recorder and reproducing devices, such as a hard disk drive unit.
[0002]
[Description of the Prior Art] In recent years, in the computer field, use is prosperous in magnetic recording media, such as a hard disk drive unit, as mass external storage in which random access is possible. And the demand to large-capacity-izing of storage capacity and a raise in recording density is increasing increasingly with expansion of use. Then, since various in order to meet such a demand, researches and developments are made.
[0003] The thing of structure which two or more disks which come to prepare a magnetic layer on a disc-like nonmagnetic substrate put in the shape of a cylinder, is prepared, and was made to position by generally moving the head for record playback arranged through an arm in each of this disk side by the actuator as a hard disk drive unit is known. In case the hard disk drive unit of such structure performs informational record playback, a head does not contact directly the disk side rotated at high speed, but it is arranged so that the location of a request of a disk side may be accessed in the condition of having risen to surface slightly, it records a signal to the truck of the shape of a concentric circle formed in the disk side, or is reproduced.
[0004] In the above-mentioned hard disk drive unit, in order to meet the demand of large-capacity-izing of memory capacity, the attempt which is going to raise recording density is made by raising recording density or raising track density until now by raising the track recording density of a disk, i.e., the consistency of the direction of a truck. In recent years, in order to raise recording density further, researches and developments of the contact record which a head is mostly contacted to a record medium and carries out record playback of the signal are also done energetically.
[0005] Vertical magnetic recording is known as one of the approaches of raising track recording density. Compared with the magnetic-recording method within a field which has an anisotropy in the conventional field inboard, the demagnetizing field in a magnetization transition part became very small on the principle, and this vertical magnetic recording became able [magnetization transition width of face] to record on high density narrowly. Moreover, by the perpendicular magnetic head using a strip-of-paper-like soft magnetism thin film, the record field of a more nearly perpendicular direction is acquired and it is checked that it is effective in densification. Furthermore, in order to gather record and regeneration efficiency and to form steeper magnetization transition, to the bottom of a perpendicular anisotropy layer, the perpendicular two-layer structure magnetic-recording medium which prepared the soft magnetism backing layer is also proposed, and development is advanced. By the magnetic interaction of a head and a soft magnetism backing layer, this perpendicular two-layer structure magnetic-recording medium can reduce the demagnetizing field at a head tip, and can acquire a bigger generating field. Moreover, at the time of playback, since the demagnetizing field in a head tip is small, the effective permeability can become large, the magnetic flux from a medium can converge on a head efficiently, and a big signal can be acquired.
[0006] However, in the above-mentioned conventional perpendicular two-layer structure magnetic-recording medium, when a soft magnetism backing layer was used, the magnetic domain wall of a soft magnetism layer moved to

discontinuity by the feeble field from the head magnetized by the pressure by contact and playback magnetic flux of a head at the time of signal regeneration etc., the pulse-like noise occurred, and there was a problem of reducing a signal quality remarkably. Moreover, if the soft magnetic characteristics of a backing layer become good while that the coercive force of a soft magnetism backing layer is small (permeability is large) can gather record regeneration efficiency by the magnetic interaction of a head and a soft magnetism backing layer Conversely, it becomes easy to move a magnetic domain wall, and during signal regeneration, the pulse-like noise by domain wall displacement occurred, the signal quality deteriorated by this, the error rate of signal regeneration went up, and there was a problem of spoiling dependability.

[0007]

[Problem(s) to be Solved by the Invention] When a soft magnetism backing layer was used, and the magnetic domain wall of a soft magnetism layer moved to discontinuity by the feeble field from the head magnetized by the pressure by contact and playback magnetic flux of a head at the time of signal regeneration etc., the pulse-like noise occurred and there was [as mentioned above,] a problem of reducing a signal quality remarkably. Moreover, if the soft magnetic characteristics of a soft magnetism backing layer become good while that the coercive force of a soft magnetism backing layer is small (permeability is large) can gather record regeneration efficiency by the magnetic interaction of a head and a soft magnetism backing layer Conversely, it becomes easy to move a magnetic domain wall, and during signal regeneration, the pulse-like noise by domain wall displacement occurred, the signal quality deteriorated by this, the error rate of signal regeneration went up, and there was a problem of spoiling dependability.

[0008] Then, this invention aims at offering the magnetic-recording medium suitable for high density record by controlling the domain wall displacement of the soft magnetism backing layer at the time of signal regeneration, and controlling generating of a pulse-like noise effectively.

[0009]

[Means for Solving the Problem] In the magnetic recorder and reproducing device with which the magnetic recorder and reproducing device of this invention consists of the magnetic head to which the magnetization record layer which has a soft magnetism backing layer and a perpendicular magnetic anisotropy on a substrate carries out record playback of the signal magnetization to the vertical-magnetic-recording medium by which the laminating was carried out, and this vertical-magnetic-recording medium, said magnetic head possesses the field generating component which can impress a field to the predetermined field of said soft magnetism backing layer at the time of signal regeneration.

[0010] And it is made for the magnetic field strength in a magnetization record layer to become smaller than the coercive force of the perpendicular direction of a magnetization record layer more greatly than the coercive force which a soft magnetism backing layer has as for the magnetic field strength in the soft magnetism backing layer at the time of the signal regeneration of said magnetic head.

[0011] Moreover, the distance d and said soft magnetism backing layer from the current core of current density J of said field generating component being the conductor of the cross section S, and flowing said field generating component to said soft magnetism backing layer are coercive force Hc. To a case, it is J. > It is made to satisfy 2pidHc/S.

[0012]

[Function] According to this invention, the sense current which flows the magnetic head at the time of signal regeneration extinguishes a magnetic domain wall by making the interior of the soft magnetism backing layer directly under the magnetic head generate the field of field inboard, and fixing the magnetic domain wall of a soft magnetism layer by the field, or making an one direction magnetized. Therefore, without affecting record magnetization of a perpendicular magnetic-anisotropy layer, the domain wall displacement of a soft magnetism backing layer can be controlled, and can control generating of the pulse-like noise by rapid domain wall displacement.

[0013] Moreover, holding power Hc of a soft magnetism backing layer If a big impression field is impressed to a soft magnetism backing layer, the magnetic domain wall in the soft magnetism backing layer located in the perimeter of a head playback component will fix, and rapid domain wall displacement will not happen in directly under [where the playback sensibility of a head playback component is the highest / head]. Here, an impression field is a direct-current field by the direct current or the hard magnetic film, or an alternating current field by alternating current. Moreover, when an alternating current field, especially a high-frequency field are impressed, originally the soft magnetism backing layer which is a domain-wall-displacement mold repeats the flux reversal of a magnetization rotation mold, and domain wall displacement stops being able to occur easily. Furthermore, this impression field does not affect at all

magnetization of the magnetization record layer which bears a record signal by making smaller than the coercive force of a magnetization record layer magnetic field strength of the impression field in the magnetization record layer which has a perpendicular anisotropy.
[0014] Therefore, since magnetization of a magnetization record layer does not receive effect in an impression field at all while according to this invention being able to control the domain wall displacement of the soft magnetism backing layer at the time of signal regeneration and being able to control generating of a pulse-like noise effectively, degradation of a signal quality can be prevented.
[0015]
[Example] Hereafter, the example of this invention is explained with reference to a drawing.
(Example 1)
[0016] Drawing 1 is the partial cross-section perspective view showing the configuration of the magnetic recorder and reproducing device concerning one example of this invention. The magnetic recorder and reproducing device of this example consists of the magnetic head 1 and a vertical-magnetic-recording medium 2.
[0017] The magnetic head 1 is a magneto-resistive effect component (MR component) which consists of thickness 0.02 for reproducing the magnetization signal recorded on the vertical-magnetic-recording medium [mum], a permalloy thin film of height 3 [mum], etc., and is opposite-**(ed) by the vertical-magnetic-recording medium 2 by non-contact through the arm 3. Moreover, this magnetic head 1 is positioned by the vertical-magnetic-recording medium 2 with an actuator (not shown) on the truck 4 of the request by which two or more formation was carried out at the shape of a concentric circle.
[0018] On the substrate 5 disc-like [nonmagnetic] in the vertical-magnetic-recording medium 2, the laminating of the soft magnetism backing layer 6 and the magnetization record layer 7 which has a perpendicular magnetic anisotropy is carried out one by one, and the protective layer 8 is further formed on it. Specifically, thickness 0.1 [mum] formation of the soft magnetism backing layer 2 which consists of a CoZrNb microcrystal by the RF spatter in an argon gas ambient atmosphere on the glass substrate 5 of the thickness 0.4 of the diameter of 1.8 inch [mm] was carried out. The field inboard coercive force Hcs of the soft magnetism backing layer 6 was 10 [Oe]. Furthermore on it, the magnetization record layer 7 which has the perpendicular magnetic anisotropy which consists of CoPt of thickness 0.07 [mum] by the DC magnetron sputtering method in an argon gas ambient atmosphere was formed. The perpendicular direction coercive force Hch of the magnetization record layer 7 was 2000 [Oe]. On the magnetization record layer 7, in order to secure the endurance over contact of a head, thickness 0.01 [mum] formation of the protective layer 8 which consists of hard carbon was carried out by the microwave excitation ECR spatter.
[0019] Drawing 2 is the mimetic diagram showing the longitudinal section of a head and the medium relative-displacement direction. The vertical-magnetic-recording medium 2 rotates towards the drawing Nakaya mark A. the cross section S of the magnetic head 1 -- 6x10-14m2 it is -- spacing of the magnetic head 1 and the lubrication protective coat 8 of a vertical-magnetic-recording medium front face was 0.01 [mum]. In the magnetic head 1, the sense current I of current density J was passed crosswise [of a truck] (direction perpendicular to space) at the time of signal regeneration. In addition, current density J, the cross section S, and the sense current I serve as relation of J=I/S. Moreover, this sense current I is a current for impressing Field H, and, thereby, has a function as a field generating component in the soft magnetism backing layer 6 while it is a current for changing resistance change of MR component into electrical-potential-difference change. The distance d from the core of the sense current I of flowing the magnetic head 1 to the front face of the soft magnetism backing layer 2 was 1.59 [mum]. And the current density J of the current which flows the magnetic head 1 is [0020].
[Equation 1] 1.33x1011 A/m2 in order to carry out as [satisfy / J>2pidHcs/S] It is 2x1011 A/m2 so that it may become above. It set up.
[0021] The sense current I which flows the magnetic head 1 of the magnetic recorder and reproducing device constituted as mentioned above extinguishes a magnetic domain wall by making the interior of the soft magnetism backing layer 6 of magnetic-head 1 directly under generate the field H of field inboard, and fixing the magnetic domain wall of a soft magnetism layer by the field, or making an one direction magnetized. Therefore, without affecting record magnetization of the perpendicular magnetic-anisotropy layer 7, the domain wall displacement of the soft magnetism backing layer 6 was able to be controlled, could control generating of the pulse-like noise by rapid domain wall displacement, and was able to raise the signal quality.
[0022] Moreover, when alternating current I, i.e., the sense current of a frequency 1 [MHz], was passed to the magnetic

head 1 and a high-frequency field was impressed, since the soft magnetism backing layer 6 which is a domain-wall-displacement mold originally repeated the flux reversal of a magnetization rotation mold, domain wall displacement stopped being able to occur easily and generating of a pulse-like noise was able to be controlled.
[0023] In addition, the magnetic field strength in the perpendicular magnetic-anisotropy layer 7 interior at the time of signal regeneration is a maximum of 16 [Oe], and since it is far smaller than coercive force Hch=2000[Oe] of the perpendicular magnetic-anisotropy layer 7, it does not affect record magnetization.
[0024] Table 1 shows the gain of the pulse-like noise from the regenerative-signal output and the soft magnetism backing layer 6 at the time of changing various J/(2pidHcs/S) by making into a parameter current density J of the current passed to the magnetic head 1.
[0025]
[Table 1]

J／（2πdHcs／S）	パルス状ノイズ振幅／再生信号出力
3．00	0．014
1．50	0．021
1．10	0．045
0．90	0．150
0．50	0．240

[0026] If the current density J of the current passed to the magnetic head 1 increases and J/(2pidHcs/S) increases from Table 1, the gain of a pulse-like noise will become small and a signal quality will improve. If J/(2pidHcs/S) becomes large and satisfies a formula 1 from 1 especially, a pulse-like noise will be controlled rapidly and it will be less than the value (0.05) which is the standard which works a recording device errorless.
(Example 2)
[0027] Drawing 3 is drawing of longitudinal section showing the configuration of the magnetic recorder and reproducing device concerning one example of this invention. The magnetic head 1 for reproducing the magnetization signal recorded on the vertical-magnetic-recording medium 2 is the induction type perpendicular magnetic head, the magnetic pole 11 which has a coil 10 is specifically formed in one side face of the base 9, and the closure of these is carried out by the insulating layer 12 and protection resin 13. This magnetic pole 11 is formed with the FeSiN quantity permeability film. Moreover, fitting is carried out to the base of the base 9 so that the hard magnetism material 14 which consists of CoSm may not contact a magnetic pole 11. This hard magnetism material 14 is magnetized by Magnetization M almost in parallel to the field of the vertical-magnetic-recording medium 2.
[0028] On the other hand, the vertical-magnetic-recording medium 2 carried out thickness 0.12 [mum] formation of the soft magnetism backing layer 15 which consists of FeSi by the DC magnetron sputtering method in an argon gas ambient atmosphere on the glass substrate 5 of the thickness 0.635 of the diameter of 2.5 inch [mm]. The field inboard

coercive force Hcs of this soft magnetism backing layer 15 was 6 [Oe]. Furthermore on it, the magnetization record layer 33 which has the perpendicular magnetic anisotropy which consists of a CoCr alloy of thickness 0.1 [mum] was formed by the DC magnetron sputtering method in the argon gas ambient atmosphere through the spatter carbon interlayer 16 of thickness 0.04 [mum]. The coercive force Hch of the perpendicular direction of the magnetic-recording layer 17 which has the perpendicular magnetic anisotropy which consists of this CoCr was 1600 [Oe]. On the magnetization record layer 17, in order to secure the endurance over contact of a head, thickness 0.005 [mum] formation of the protective coat 18 which consists of SiN was carried out by RF spatter.

[0029] The hard magnetism material 14 of Magnetization M impresses a field to the soft magnetism backing layer 15 by the magnetization, and domain wall displacement is controlled like an example 1 by the above configurations. Therefore, the pulse-like noise by the domain wall displacement of the soft magnetism backing layer 15 can be reduced, and a signal quality can be raised.

[0030] In addition, the impression magnetic field strength within the soft magnetism backing layer 15 which can set this example is about 30 [Oe], and since it has exceeded the coercive force Hcs of the soft magnetism backing layer 15, an impression field does not affect at all magnetization of the magnetization record layer which bears a record signal.

(Example 3)

[0031] Drawing 4 is the partial cross-section perspective view showing the configuration of the magnetic recorder and reproducing device concerning one example of this invention. The conductors 21 and 21 for the magnetic head 1 to introduce the sense current I into the hard magnetism material 20 and 20 and the MR component 19 which become the both ends of the MR component 19 from CoPt of thickness 0.02 [mum] are formed. the conductor of conductors 21 and 21 -- the width of recording track Tw by which the between distance D is formed in a vertical-magnetic-recording medium It specifies. in addition, the conductor of conductors 21 and 21 -- the between distance D and the width of recording track Tw relation -- D>Tw It is desirable.

[0032] The vertical-magnetic-recording medium 2 carried out thickness 0.2 [mum] formation of the soft magnetism backing layer 22 which consists of NiFe on the substrate 5 made from the aluminum of the thickness 0.635 of the diameter of 2.5 inch [mm] by the DC magnetron sputtering method in the argon gas ambient atmosphere. The field inboard coercive force Hcs of the soft magnetism backing layer 22 was 12 [Oe]. the magnetization record layer 23 which furthermore has the perpendicular magnetic anisotropy which consists of CoCrTa on it -- the inside of an argon gas ambient atmosphere -- the DC magnetron sputtering method -- thickness 0.08 [mum] -- having formed . The perpendicular direction coercive force Hch of this magnetization record layer 23 was 1900 [Oe]. On the magnetization record layer 23, in order to secure the endurance over contact of a head, thickness 0.007 [mum] formation of the insulating protective coat 24 which consists of ZrO was carried out by RF spatter.

[0033] The hard magnetism material 20 and 20 has Magnetization M crosswise [of a truck] (radial [of a substrate]), and impresses the field of the truck cross direction to the interior of a soft magnetism backing layer by the magnetization M. The magnetic field strength of the truck cross direction by the hard magnetism material 20 and 20 is about 20 [Oe], and exceeds the coercive force Hcs of the soft magnetism backing layer 23. Thereby, the pulse-like noise by the domain wall displacement of the soft magnetism backing layer 23 was able to be reduced, and the signal quality as well as the above-mentioned example was able to be raised.

[0034] In addition, in the example of this invention, although the laminating of a soft magnetism backing layer and the magnetization record layer was carried out only to one field of a substrate, you may be the vertical-magnetic-recording medium of the double-sided mold which did not adhere to this and carried out the laminating also to the field of another side of a substrate.

[0035]

[Effect of the Invention] According to this invention, even if it is a vertical-magnetic-recording medium using a soft magnetism backing layer, the domain wall displacement of the soft magnetism backing layer at the time of signal regeneration can be controlled, and generating of a pulse-like noise can be controlled effectively. Moreover, since magnetization of a magnetization record layer does not receive effect in an impression field at all, degradation of a signal quality can be prevented. Therefore, it becomes possible to acquire the regenerative signal of the big high quality of SN, without spoiling the high density recording characteristic of a vertical magnetic recording.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]
[Industrial Application] This invention relates to the magnetic recorder and reproducing device constituted by the magnetic head which reproduces the signal magnetization recorded on the vertical-magnetic-recording medium and this vertical-magnetic-recording medium of the two-layer structure where the soft magnetism layer was backed by especially the perpendicular magnetic-anisotropy layer about magnetic recorder and reproducing devices, such as a hard disk drive unit.

[0002]
[Description of the Prior Art] In recent years, in the computer field, use is prosperous in magnetic recording media, such as a hard disk drive unit, as mass external storage in which random access is possible. And the demand to large-capacity-izing of storage capacity and a raise in recording density is increasing increasingly with expansion of use. Then, since various in order to meet such a demand, researches and developments are made.

[0003] The thing of structure which two or more disks which come to prepare a magnetic layer on a disc-like nonmagnetic substrate put in the shape of a cylinder, is prepared, and was made to position by generally moving the head for record playback arranged through an arm in each of this disk side by the actuator as a hard disk drive unit is known. In case the hard disk drive unit of such structure performs informational record playback, a head does not contact directly the disk side rotated at high speed, but it is arranged so that the location of a request of a disk side may be accessed in the condition of having risen to surface slightly, it records a signal to the truck of the shape of a concentric circle formed in the disk side, or is reproduced.

[0004] In the above-mentioned hard disk drive unit, in order to meet the demand of large-capacity-izing of memory capacity, the attempt which is going to raise recording density is made by raising recording density or raising track density until now by raising the track recording density of a disk, i.e., the consistency of the direction of a truck. In recent years, in order to raise recording density further, researches and developments of the contact record which a head is mostly contacted to a record medium and carries out record playback of the signal are also done energetically.

[0005] Vertical magnetic recording is known as one of the approaches of raising track recording density. Compared with the magnetic-recording method within a field which has an anisotropy in

the conventional field inboard, the demagnetizing field in a magnetization transition part became very small on the principle, and this vertical magnetic recording became able [magnetization transition width of face] to record on high density narrowly. Moreover, by the perpendicular magnetic head using a strip-of-paper-like soft magnetism thin film, the record field of a more nearly perpendicular direction is acquired and it is checked that it is effective in densification. Furthermore, in order to gather record and regeneration efficiency and to form steeper magnetization transition, to the bottom of a perpendicular anisotropy layer, the perpendicular two-layer structure magnetic-recording medium which prepared the soft magnetism backing layer is also proposed, and development is advanced. By the magnetic interaction of a head and a soft magnetism backing layer, this perpendicular two-layer structure magnetic-recording medium can reduce the demagnetizing field at a head tip, and can acquire a bigger generating field. Moreover, at the time of playback, since the demagnetizing field in a head tip is small, the effective permeability can become large, the magnetic flux from a medium can converge on a head efficiently, and a big signal can be acquired.

[0006] However, in the above-mentioned conventional perpendicular two-layer structure magnetic-recording medium, when a soft magnetism backing layer was used, the magnetic domain wall of a soft magnetism layer moved to discontinuity by the feeble field from the head magnetized by the pressure by contact and playback magnetic flux of a head at the time of signal regeneration etc., the pulse-like noise occurred, and there was a problem of reducing a signal quality remarkably. Moreover, if the soft magnetic characteristics of a backing layer become good while that the coercive force of a soft magnetism backing layer is small (permeability is large) can gather record regeneration efficiency by the magnetic interaction of a head and a soft magnetism backing layer Conversely, it becomes easy to move a magnetic domain wall, and during signal regeneration, the pulse-like noise by domain wall displacement occurred, the signal quality deteriorated by this, the error rate of signal regeneration went up, and there was a problem of spoiling dependability.

[0007]
[Problem(s) to be Solved by the Invention] When a soft magnetism backing layer was used, and the magnetic domain wall of a soft magnetism layer moved to discontinuity by the feeble field from the head magnetized by the pressure by contact and playback magnetic flux of a head at the time of signal regeneration etc., the pulse-like noise occurred and there was [as mentioned above,] a problem of reducing a signal quality remarkably. Moreover, if the soft magnetic characteristics of a soft magnetism backing layer become good while that the coercive force of a soft magnetism backing layer is small (permeability is large) can gather record regeneration efficiency by the magnetic interaction of a head and a soft magnetism backing layer Conversely, it becomes easy to move a magnetic domain wall, and during signal regeneration, the pulse-like noise by domain wall displacement occurred, the signal quality deteriorated by this, the error rate of signal regeneration went up, and there was a problem of spoiling dependability.

[0008] Then, this invention aims at offering the magnetic-recording medium suitable for high density record by controlling the domain wall displacement of the soft magnetism backing layer at the time of signal regeneration, and controlling generating of a pulse-like noise effectively.

[0009]
[Means for Solving the Problem] In the magnetic recorder and reproducing device with which the magnetic recorder and reproducing device of this invention consists of the magnetic head to which the magnetization record layer which has a soft magnetism backing layer and a perpendicular magnetic anisotropy on a substrate carries out record playback of the signal magnetization to the vertical-magnetic-recording medium by which the laminating was carried out, and this vertical-magnetic-recording medium, said magnetic head possesses the field generating component which can impress a field to the predetermined field of said soft magnetism backing layer at the time of signal regeneration.

[0010] And it is made for the magnetic field strength in a magnetization record layer to become smaller than the coercive force of the perpendicular direction of a magnetization record layer more greatly than the coercive force which a soft magnetism backing layer has as for the magnetic field strength in the soft magnetism backing layer at the time of the signal regeneration of said magnetic head.

[0011] Moreover, the distance d and said soft magnetism backing layer from the current core of current density J of said field generating component being the conductor of the cross section S, and flowing said field generating component to said soft magnetism backing layer are coercive force Hc. To a case, it is J. > It is made to satisfy 2pidHc/S.

[0012]
[Function] According to this invention, the sense current which flows the magnetic head at the time of signal regeneration extinguishes a magnetic domain wall by making the interior of the soft magnetism backing layer directly under the magnetic head generate the field of field inboard, and fixing the magnetic domain wall of a soft magnetism layer by the field, or making an one direction magnetized. Therefore, without affecting record magnetization of a perpendicular magnetic-anisotropy layer, the domain wall displacement of a soft magnetism backing layer can be controlled, and can control generating of the pulse-like noise by rapid domain wall displacement.

[0013] Moreover, holding power Hc of a soft magnetism backing layer If a big impression field is impressed to a soft magnetism backing layer, the magnetic domain wall in the soft magnetism backing layer located in the perimeter of a head playback component will fix, and rapid domain wall displacement will not happen in directly under [where the playback sensibility of a head playback component is the highest / head]. Here, an impression field is a direct-current field by the direct current or the hard magnetic film, or an alternating current field by alternating current. Moreover, when an alternating current field, especially a high-frequency field are impressed, originally the soft magnetism backing layer which is a domain-wall-displacement mold repeats the flux reversal of a magnetization rotation mold, and domain wall displacement stops being able to occur easily. Furthermore, this impression field does not affect at all magnetization of the magnetization record layer which bears a record signal by making smaller than the coercive force of a magnetization record layer magnetic field strength of the impression field in the magnetization record layer which has a perpendicular anisotropy.

[0014] Therefore, since magnetization of a magnetization record layer does not receive effect in

an impression field at all while according to this invention being able to control the domain wall displacement of the soft magnetism backing layer at the time of signal regeneration and being able to control generating of a pulse-like noise effectively, degradation of a signal quality can be prevented.

[0015]
[Example]
Hereafter, the example of this invention is explained with reference to a drawing.

(Example 1)

[0016] Drawing 1 is the partial cross-section perspective view showing the configuration of the magnetic recorder and reproducing device concerning one example of this invention. The magnetic recorder and reproducing device of this example consists of the magnetic head 1 and a vertical-magnetic-recording medium 2.

[0017] The magnetic head 1 is a magneto-resistive effect component (MR component) which consists of thickness 0.02 for reproducing the magnetization signal recorded on the vertical-magnetic-recording medium [mum], a permalloy thin film of height 3 [mum], etc., and is opposite-**(ed) by the vertical-magnetic-recording medium 2 by non-contact through the arm 3. Moreover, this magnetic head 1 is positioned by the vertical-magnetic-recording medium 2 with an actuator (not shown) on the truck 4 of the request by which two or more formation was carried out at the shape of a concentric circle.

[0018] On the substrate 5 disc-like [nonmagnetic] in the vertical-magnetic-recording medium 2, the laminating of the soft magnetism backing layer 6 and the magnetization record layer 7 which has a perpendicular magnetic anisotropy is carried out one by one, and the protective layer 8 is further formed on it. Specifically, thickness 0.1 [mum] formation of the soft magnetism backing layer 2 which consists of a CoZrNb microcrystal by the RF spatter in an argon gas ambient atmosphere on the glass substrate 5 of the thickness 0.4 of the diameter of 1.8 inch [mm] was carried out. The field inboard coercive force Hcs of the soft magnetism backing layer 6 was 10 [Oe]. Furthermore on it, the magnetization record layer 7 which has the perpendicular magnetic anisotropy which consists of CoPt of thickness 0.07 [mum] by the DC magnetron sputtering method in an argon gas ambient atmosphere was formed. The perpendicular direction coercive force Hch of the magnetization record layer 7 was 2000 [Oe]. On the magnetization record layer 7, in order to secure the endurance over contact of a head, thickness 0.01 [mum] formation of the protective layer 8 which consists of hard carbon was carried out by the microwave excitation ECR spatter.

[0019] Drawing 2 is the mimetic diagram showing the longitudinal section of a head and the medium relative-displacement direction. The vertical-magnetic-recording medium 2 rotates towards the drawing Nakaya mark A. the cross section S of the magnetic head 1 -- 6x10-14m2 it is -- spacing of the magnetic head 1 and the lubrication protective coat 8 of a vertical-magnetic-recording medium front face was 0.01 [mum]. In the magnetic head 1, the sense current I of current density J was passed crosswise [of a truck] (direction perpendicular to space) at the time of signal regeneration. In addition, current density J, the cross section S, and the sense current I

serve as relation of J=I/S. Moreover, this sense current I is a current for impressing Field H, and, thereby, has a function as a field generating component in the soft magnetism backing layer 6 while it is a current for changing resistance change of MR component into electrical-potential-difference change. The distance d from the core of the sense current I of flowing the magnetic head 1 to the front face of the soft magnetism backing layer 2 was 1.59 [mum]. And the current density J of the current which flows the magnetic head 1 is

[0020].

[Equation 1] 1.33x1011 A/m2 in order to carry out as [satisfy / J>2pidHcs/S] It is 2x1011 A/m2 so that it may become above. It set up.

[0021] The sense current I which flows the magnetic head 1 of the magnetic recorder and reproducing device constituted as mentioned above extinguishes a magnetic domain wall by making the interior of the soft magnetism backing layer 6 of magnetic-head 1 directly under generate the field H of field inboard, and fixing the magnetic domain wall of a soft magnetism layer by the field, or making an one direction magnetized. Therefore, without affecting record magnetization of the perpendicular magnetic-anisotropy layer 7, the domain wall displacement of the soft magnetism backing layer 6 was able to be controlled, could control generating of the pulse-like noise by rapid domain wall displacement, and was able to raise the signal quality.

[0022] Moreover, when alternating current I, i.e., the sense current of a frequency 1 [MHz], was passed to the magnetic head 1 and a high-frequency field was impressed, since the soft magnetism backing layer 6 which is a domain-wall-displacement mold originally repeated the flux reversal of a magnetization rotation mold, domain wall displacement stopped being able to occur easily and generating of a pulse-like noise was able to be controlled.

[0023] In addition, the magnetic field strength in the perpendicular magnetic-anisotropy layer 7 interior at the time of signal regeneration is a maximum of 16 [Oe], and since it is far smaller than coercive force Hch=2000[Oe] of the perpendicular magnetic-anisotropy layer 7, it does not affect record magnetization.

[0024] Table 1 shows the gain of the pulse-like noise from the regenerative-signal output and the soft magnetism backing layer 6 at the time of changing various J/(2pidHcs/S) by making into a parameter current density J of the current passed to the magnetic head 1.

[0025]

[Table 1]

J／（2πdHcs／S）	パルス状ノイズ振幅／再生信号出力
3．００	０．０１４
１．５０	０．０２１
１．１０	０．０４５
０．９０	０．１５０
０．５０	０．２４０

[0026] If the current density J of the current passed to the magnetic head 1 increases and J/(2pidHcs/S) increases from Table 1, the gain of a pulse-like noise will become small and a signal quality will improve. If J/(2pidHcs/S) becomes large and satisfies a formula 1 from 1 especially, a pulse-like noise will be controlled rapidly and it will be less than the value (0.05) which is the standard which works a recording device errorless.

(Example 2)

[0027] Drawing 3 is drawing of longitudinal section showing the configuration of the magnetic recorder and reproducing device concerning one example of this invention. The magnetic head 1 for reproducing the magnetization signal recorded on the vertical-magnetic-recording medium 2 is the induction type perpendicular magnetic head, the magnetic pole 11 which has a coil 10 is specifically formed in one side face of the base 9, and the closure of these is carried out by the insulating layer 12 and protection resin 13. This magnetic pole 11 is formed with the FeSiN quantity permeability film. Moreover, fitting is carried out to the base of the base 9 so that the hard magnetism material 14 which consists of CoSm may not contact a magnetic pole 11. This hard magnetism material 14 is magnetized by Magnetization M almost in parallel to the field of the vertical-magnetic-recording medium 2.

[0028] On the other hand, the vertical-magnetic-recording medium 2 carried out thickness 0.12 [mum] formation of the soft magnetism backing layer 15 which consists of FeSi by the DC magnetron sputtering method in an argon gas ambient atmosphere on the glass substrate 5 of the thickness 0.635 of the diameter of 2.5 inch [mm]. The field inboard coercive force Hcs of this soft magnetism backing layer 15 was 6 [Oe]. Furthermore on it, the magnetization record layer 33 which has the perpendicular magnetic anisotropy which consists of a CoCr alloy of thickness 0.1 [mum] was formed by the DC magnetron sputtering method in the argon gas ambient atmosphere through the spatter carbon interlayer 16 of thickness 0.04 [mum]. The coercive force Hch of the perpendicular direction of the magnetic-recording layer 17 which has the perpendicular magnetic anisotropy which consists of this CoCr was 1600 [Oe]. On the magnetization record layer 17, in order to secure the endurance over contact of a head, thickness 0.005 [mum] formation of the protective coat 18 which consists of SiN was carried out by RF spatter.

[0029] The hard magnetism material 14 of Magnetization M impresses a field to the soft magnetism backing layer 15 by the magnetization, and domain wall displacement is controlled like an example 1 by the above configurations. Therefore, the pulse-like noise by the domain wall displacement of the soft magnetism backing layer 15 can be reduced, and a signal quality can be raised.

[0030] In addition, the impression magnetic field strength within the soft magnetism backing layer 15 which can set this example is about 30 [Oe], and since it has exceeded the coercive force Hcs of the soft magnetism backing layer 15, an impression field does not affect at all magnetization of the magnetization record layer which bears a record signal.

(Example 3)

[0031] Drawing 4 is the partial cross-section perspective view showing the configuration of the magnetic recorder and reproducing device concerning one example of this invention. The conductors 21 and 21 for the magnetic head 1 to introduce the sense current I into the hard magnetism material 20 and 20 and the MR component 19 which become the both ends of the MR component 19 from CoPt of thickness 0.02 [mum] are formed. the conductor of conductors 21 and 21 -- the width of recording track Tw by which the between distance D is formed in a vertical-magnetic-recording medium It specifies. in addition, the conductor of conductors 21 and 21 -- the between distance D and the width of recording track Tw relation -- D>Tw It is desirable.

[0032] The vertical-magnetic-recording medium 2 carried out thickness 0.2 [mum] formation of the soft magnetism backing layer 22 which consists of NiFe on the substrate 5 made from the aluminum of the thickness 0.635 of the diameter of 2.5 inch [mm] by the DC magnetron sputtering method in the argon gas ambient atmosphere. The field inboard coercive force Hcs of the soft magnetism backing layer 22 was 12 [Oe]. the magnetization record layer 23 which furthermore has the perpendicular magnetic anisotropy which consists of CoCrTa on it -- the inside of an argon gas ambient atmosphere -- the DC magnetron sputtering method -- thickness 0.08 [mum] -- having formed . The perpendicular direction coercive force Hch of this magnetization record layer 23 was 1900 [Oe]. On the magnetization record layer 23, in order to

secure the endurance over contact of a head, thickness 0.007 [mum] formation of the insulating protective coat 24 which consists of ZrO was carried out by RF spatter.

[0033] The hard magnetism material 20 and 20 has Magnetization M crosswise [of a truck] (radial [of a substrate]), and impresses the field of the truck cross direction to the interior of a soft magnetism backing layer by the magnetization M. The magnetic field strength of the truck cross direction by the hard magnetism material 20 and 20 is about 20 [Oe], and exceeds the coercive force Hcs of the soft magnetism backing layer 23. Thereby, the pulse-like noise by the domain wall displacement of the soft magnetism backing layer 23 was able to be reduced, and the signal quality as well as the above-mentioned example was able to be raised.

[0034] In addition, in the example of this invention, although the laminating of a soft magnetism backing layer and the magnetization record layer was carried out only to one field of a substrate, you may be the vertical-magnetic-recording medium of the double-sided mold which did not adhere to this and carried out the laminating also to the field of another side of a substrate.

[0035]
[Effect of the Invention] According to this invention, even if it is a vertical-magnetic-recording medium using a soft magnetism backing layer, the domain wall displacement of the soft magnetism backing layer at the time of signal regeneration can be controlled, and generating of a pulse-like noise can be controlled effectively. Moreover, since magnetization of a magnetization record layer does not receive effect in an impression field at all, degradation of a signal quality can be prevented. Therefore, it becomes possible to acquire the regenerative signal of the big high quality of SN, without spoiling the high density recording characteristic of a vertical magnetic recording.

[Translation done.]

JP6076202

Publication Title:

MAGNETIC RECORDING AND REPRODUCING DEVICE

Abstract:

PURPOSE:To suppress the generation of impulsive noises by providing a magnetic field generating element which can impress magnetic fields to the prescribed region of a soft magnetic backing layer at the time of signal reproduction.

CONSTITUTION:This perpendicular magnetic recording medium 2 is constituted by successively laminating the soft magnetic backing layer 6 and a magnetization recording layer 7 having perpendicular magnetic anisotropy on a nonmagnetic disk-shaped substrate 5. Further, a protective layer 8 is formed thereon. Sense current I flowing in the magnetic head 1 of this magnetic recording and reproducing device generates the magnetic field H in an intra-surface direction within the soft magnetic backing layer 6 right under the magnetic head 1 and the magnetic walls of the soft magnetic layer are fixed by this magnetic field or is magnetized in one direction, by which the magnetic walls are dissipated. Then, the magnetic wall transfer of the soft magnetic backing layer 6 is suppressed without affecting the recording magnetization of the perpendicular magnetic anisotropy layer 7. The generation of the impulsive noises by the abrupt magnetic wall transfer is suppressed.
